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CONTENTS

PAGE

CROSSKEY, R. W., B.Sc., F.R.E.S., and CROSSKEY, M. E., B.Sc., F.R.E.S. The horse-flies (DIPTERA : TABANIDAE) of Nigeria and the British Cameroons . . . . . 341–374, 60 figs.

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THE HORSE-FLIES (DIPTERA: TABANIDAE) OF NIGERIA AND THE BRITISH CAMEROONS.

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AND

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With 60 Text-figures.

Contents.

	PAGE
1. Introduction	341
2. Acknowledgments	343
3. The Country and Climate	343
4. Distribution	345
(*a*) Locality records	345
(*b*) Relation to vegetation	360
5. Bionomics	364
(*a*) Immature stages and breeding-sites	364
(*b*) Habits of the adult	365
(*c*) Seasonal prevalence	367
6. Economic and Medical Importance	370
(*a*) Relation to trypanosomiasis	370
(*b*) Relation to loiasis	371
7. References	372

1. Introduction.

During the early years of the present century it was commonly thought that the African Tabanidae, because of their abundance and their voracious blood-sucking habits, were probably implicated in the transmission of certain diseases of man and livestock, notably trypanosomiasis. This possiblity gave rise to considerable collecting fever throughout Africa, and many new species came to light and were named, largely by Austen, between 1900 and 1918. Between those years a number of persons in West Africa, especially Medical Officers, began assiduously to collect specimens and record notes upon the Tabanid fauna, and, by 1912, Simpson (1912*a*, *b*) was able to give a fairly comprehensive list of the Nigerian species of the family. In the following year Leiper (1913), working in Nigeria, established that the development of *Loa loa* could

take place in the salivary glands of *Chrysops* and this discovery encouraged further collecting endeavours.

Other medical officers made useful studies of the Tabanid faunas existing in the areas in which they were stationed and some of these were published, notably by Mayer (1911) on the species of Ilesha and Oshogbo Districts, Southern Nigeria, and by Johnston (1916) on Kaduna District, Northern Nigeria. Between the years 1914 and 1928 the Annual Reports of the Medical Research Institute, Lagos, contained lists of Tabanidae obtained by doctors working in all parts of Nigeria, and especially useful are the lists of species from Ibi District, and from voyages undertaken up the Niger and Benue Rivers. Simpson (1912*a*, *b*) was indefatigable in collecting zeal and meticulous in recording data, so that his two lengthy papers, recording almost every detail of his research expeditions, form the most important single item in our knowledge of the Tabanidae of Nigeria and the British Cameroons.

By 1926 it was clear that, so far as Nigeria was concerned, only *Chrysops* was to be incriminated as a vector of disease, and that Tabanidae were not responsible for the transmission of human sleeping sickness. From this time there was a very marked slackening of interest in the family, and after 1928 the Medical Research Institute ceased to gather and publish Tabanid records. Interest in Tabanidae was not reawakened until about 1948, when a Loiasis Research Scheme commenced in the Cameroons. In the twenty years between 1928 and 1948 there were only two published articles concerning Nigerian Tabanidae. These were some notes on the Tabanids of Ilorin Province by Golding (1938), and a list of the insect pests of stock by the same author (Golding, 1946).

In recent years a number of papers have been published on various aspects of the biology of *Chrysops*, some species of which are the proven vectors of loiasis in Southern Nigeria and the Cameroons; these papers include Gordon, Chwatt and Jones (1948), Chwatt, Gordon and Jones (1948), Davey & O'Rourke (1951*a*, *b*, *c*,) Crewe and O'Rourke (1951), Crewe (1953), and Kettle (1953).

The earliest attempt to list the Nigerian species of Tabanidae was that of Simpson (1912*a*, *b*). Simpson recorded 51 species, of which 17 were known only from Northern Nigeria, 15 from Southern Nigeria, while 19 species were common to north and south. The species were next enumerated by Golding (1946) who gave 60 species, but some of his names are now regarded as synonyms; the increase in the number of species listed by Golding over those listed by Simpson was due in part to a number of new species described after Simpson's work and not only to synonymy. Recently Roche (1949, "*Keys for the identification of the Nigerian Tabanidae*") gave a key to 58 species, although he stated that 61 species were known from the country. A number of new species have recently been described by Oldroyd (1952*a*, *b*, 1954) and many new records have been obtained in the Cameroons, so that altogether the Tabanid fauna of Nigeria and the Cameroons is now constituted by 89 definitely established species and two doubtful ones. This may be compared with the 70 species given by Lewis (1953) for the Sudan.

The original descriptions of Nigerian Tabanids are to be found in the numerous systematic papers listed by Oldroyd (1952*a*, 1954, and in preparation), who also gives keys for the identification of the numerous species.

We have attempted in this paper to gather together the available information

on Nigerian Tabanidae and to present this in a comprehensive form. We had felt for some time that a general account of the Tabanid fauna of Nigeria was desirable, but it was the revival of interest generally in this family of flies, occasioned largely by the importance of *Chrysops*, that stimulated us to prepare the present paper.

We have gathered the locality data given from the published information, from our own collecting experience in many parts of Northern Nigeria, from the unpublished records of other entomologists in Nigeria, and from data labels on specimens in the collection of the British Museum (Natural History).

In classification we have followed the arrangement suggested by Mr. H. Oldroyd ; in the distribution section we have included synonyms for species only where these have appeared in the literature on Nigerian forms, or have been commonly used in correspondence between entomologists. The detailed synonymy for the species may be found in Oldroyd (1952*a*) for *Hippocentrum* and *Haemotopota*, and in Oldroyd (1954, and in preparation) for the other genera.

2. Acknowledgments.

We wish to express our gratitude to all those who have helped us in the preparation of this paper. We thank Mr. H. Oldroyd, British Museum (Natural History), for allowing one of us (M. E. C.) full use of the British Museum collection, and for very considerable help over classification and synonymy ; Dr. T. A. M. Nash, Mr. W. Crewe, Mr. R. J. Kernaghan, and Mr. H. Caswell for records ; all Veterinary Officers who have forwarded us specimens, and provided information on camel trypanosomiasis ; and the Chief Medical Advisor to the Federal Government of Nigeria, for permission to publish this paper.

3. The Country and Climate.

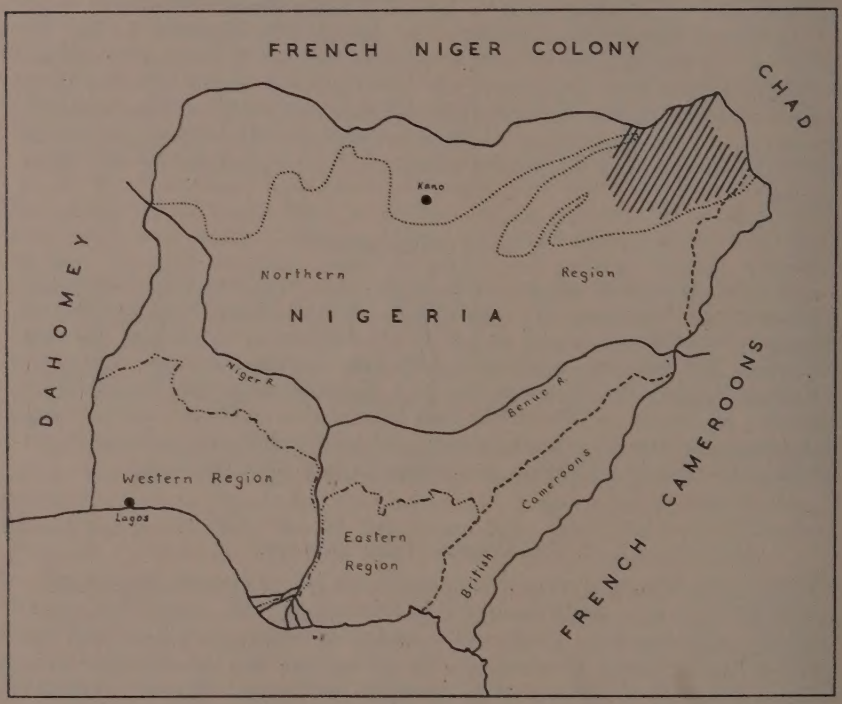
Nigeria and the British Cameroons occupy an area of 372,000 square miles—somewhat more than seven times the size of England. The country is a quadrilateral some 600 miles broad, and stretches for 600 miles inland from the Gulf of Guinea almost to the fringes of the Sahara ; the desert proper commences about 150 miles north of the boundary of Nigeria. Nigeria is bounded on three sides by territories of French West and French Equatorial Africa. To the west lies Dahomey, to the north French Niger Colony, to the north-east Chad Territory and, to the south-east the French Cameroons (Map 1). To the south Nigeria fronts the sea for about 500 miles of coastline—the old Slave Coast.

In general the country slopes from north to south, most of the Northern Region being over 2000 ft. above sea-level, while most of the south is no more than 500 ft. In the central north the Bauchi Plateau averages nearly 4000 ft., while parts of the Adamawa Massif on the border of French Cameroons reach to 6000 ft. and more. With the exception of Cameroons Mountain (13,320 ft.), there is almost no land over 8000 ft.

An idea of the general level of the country may be obtained from a consideration of the Niger and Benue Rivers. Where these great rivers enter British territory they are only some 800 and 600 ft. above sea-level respectively, yet

they are here some 700 miles from their common outlet to the sea at the Niger delta : the drop on these rivers is therefore only about one foot per mile.

The mean annual rainfall varies from the extreme of 375 in. near Victoria in the Cameroons to as little as 14 in. in the extreme north. Rainfall is shown on Map 2, together with an indication of the number of dry months in different latitudes ; a dry month is regarded as one with only one inch precipitation or less. Although the total annual rainfall may be the same in two places the



MAP 1.

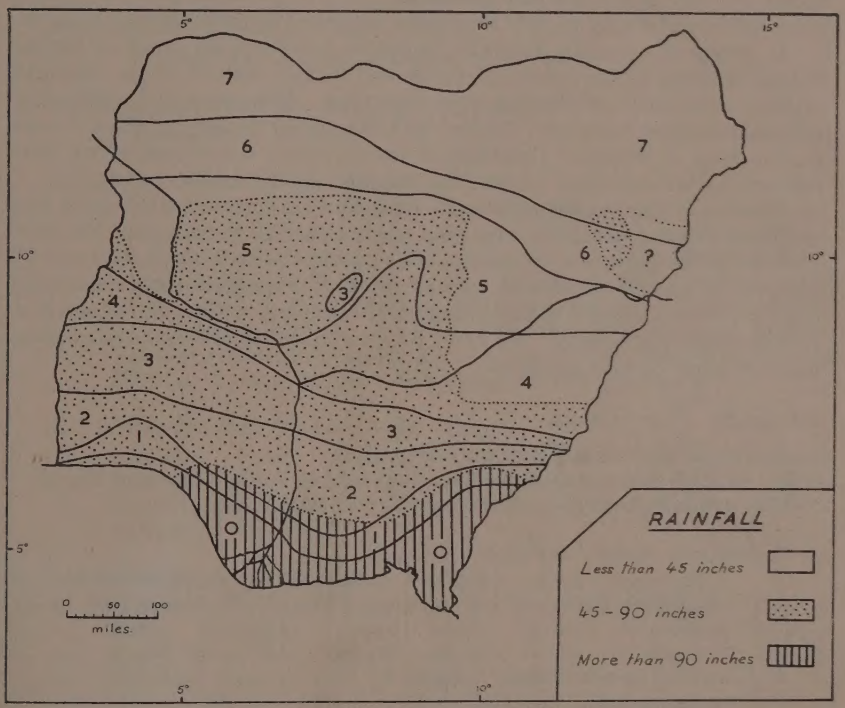
Map 1.—The regional boundaries of Nigeria and the British Cameroons. The dotted line in the Northern Region represents the northern limit of the tsetse-fly ; the cross-hatching represents the known extent of camel trypanosomiasis.

number of dry months may be very different. The wet-season commences in the north usually in April or May and ends in October or November ; the early dry-season is characterised by the Harmattan, a high wind which blows into the country from the desert to the north-east, and brings with it desiccating conditions and cold nights. The late dry-season in the north is very hot, but the dry-season in the south is cooler and shorter and the Harmattan is scarcely noticed.

In the north temperatures vary considerably throughout the year, but in the south the variation range is small, the temperature never reaching so high

or falling so low as in the north. The mean monthly maximum temperature is as high as 105° F. in Sokoto in April, but as low as 79° F. in the Cameroons in July. Similarly the mean minimum temperature for January in Lagos is 75° F., compared with only 55° F. in the same month in Maiduguri.

Being a tropical country extending over such a range of rainfall and temperature variation, Nigeria naturally shows well-marked zonation of vegetation; this has been well-described by Keay (1949) and Rosevear (1953). Vegetation varies from the dense tropical rain-forest of the Cameroons and the mangrove swamps of the coastal creeks, to the semi-desert thorn scrub of the far north.



MAP 2.

Map 2.—Rainfall and duration of the dry-season. The figures between the transverse lines represent the number of dry months in a year, i.e. months with less than one inch rainfall.

This is considered in greater detail in the section on distribution in relation to vegetation.

4. Distribution.

(a) Locality Records.

Nigeria proper is divided into three political entities, each composed of a number of Provinces. The Northern Region comprises over two-thirds of the area of Nigeria and contains twelve provinces, some of these nearly as large as

Scotland. The twelve provinces are: Sokoto, Katsina, Kano, Bornu, Ilorin, Niger, Zaria, Plateau, Bauchi, Adamawa, Kabba and Benue. The Eastern Region comprises the provinces of : Onitsha, Owerri, Rivers, Ogoja and Calabar —the total area scarcely larger than Bornu Province in the north. The Western Region comprises seven provinces, Colony, Ijebu, Abeokuta, Oyo, Ondo, Benin and Warri.

The British Cameroons comprises the provinces of Cameroons and Bamenda ; a thin sliver of Mandated Territory extends up the eastern border of Nigeria to Lake Chad (Map 1). Though technically part of the Cameroons it is administered by three of the northern provinces. It is of no importance for present purposes as no Tabanid records have yet come from this rather remote country.

In giving the locality data the names of provinces are given in capital letters, followed by the names of towns and villages nearest to the places of capture within that province in lower case type. The names and spellings of all localities given have been checked with the official *Gazetteer of Place Names* on the Map of Nigeria. Localities in the Northern Region are given first, followed by Western then Eastern Regions, and finally the Cameroons.

Thirteen genera and 89 species of Tabinidae are known from Nigeria and the British Cameroons. We have seen specimens of all these species but have included in the list below two species of doubtful validity, making a total of 91 species. The names of these two species, viz. *Tabanus combustus* and *Haematopa albihirta*, have appeared in the literature, but we have not ourselves been able to corroborate the records. We have, however, included these species on maps based on these literature records.

Sub-family : PANGONIINAE.

1. *Dasycompsa cincta* Enderlein. (Map 3.)
   CAMEROONS : Kumba (bred from larvae). Also " Southern Nigeria " (*Pomeroy*). Type from Sanaga, French Cameroons.

2. *Pangonia rüppellii* Jaennicke. (Map 3.)
   PLATEAU : Amper (*Authors*). Also possibly Southern Bornu. In the British Museum is one specimen collected in Nigeria in 1908 by Dr. Lobb.

3. *Nuceria semilivida* (Bigot). (Map 4.)
   N. mayombensis Bequaert.
   BAMENDA : Gwofon, between Mamfe and Bamenda.

4. *Subpangonia gravoti* Surcouf. (Map 4.)
   ABEOKUTA : Edi-Emi. OGOJA : Obubra.

5. *Subpangonia grahami* Austen. (Map 4.)
   OGOJA : Ikom.

6. *Thriambeutes singularis* Grünberg. (Map 5.)
   OYO : Ibadan.

7. *Thriambeutes nigripennis* (Enderlein). (Map 5.)
   CAMEROONS.

8. *Thaumastocera akwa* Grünberg. (Map 6.)

OYO : Ibadan. COLONY : Lagos. CALABAR : Calabar, Ikot-Ekpene. CAMEROONS : Kumba. Also " Nigeria " (*Pomeroy*).

9. *Tabanocella stimulans* (Austen). (Map 7.)
Rhinomyza stimulans Austen.

KABBA : R. Benue, Bagana to Lokoja. OYO : Ilesha. WARRI : Aboh. BENIN : Benin. OWERRI : Owerri. RIVERS : Ahoada. CAMEROONS : Kumba, mile 19 Kumba to Victoria road. BAMENDA : Gwofon.

10. *Tabanocella schoutedeni* Fain. (Map 6.)

CAMEROONS : between Mamfe and Bamenda.

11. *Tabanocella praestabilis* (Grünberg). (Map 5)

CAMEROONS : Kumba.

12. *Chrysops silacea* Austen. (Map 8.)

Widely distributed over the southern provinces and the Cameroons. KABBA : Ankpa, Dekina, Ayangba. BENUE : Akwatta. OYO : Oshogbo, Ilesha. ONDO : Okitipupa. BENIN : Benin, Ologbo, Ohere, Agbor, Ekpoma. WARRI : Sapele. COLONY : Epe. ONITSHA : Oji River. OGOJA : Ikom, Obubra, Abakaliki. OWERRI : Owerri, Bende, Aba, Ikpe, Ohambele. RIVERS : Port Harcourt, Ahoada, Degema. CALABAR : Eket, Calabar, Itu, Ikot-Ekpene, Opobo, Oban. CAMEROONS : Victoria, Kumba, Mamfe. BAMENDA : Gwofon, Bamenda.

13. *Chrysops dimidiata* Van der Wulp. (Map 9.)

BENIN : Benin, Ologbo. WARRI : Sapele. COLONY : Badagri. OWERRI : Akwete. RIVERS : Ahoada. CALABAR : Calabar, Eket, Ikot-Ekpene, Ndongolai. CAMEROONS : Kumba, Mamfe, Batouri. BAMENDA : Gwofon.

14. *Chrysops longicornis* Macquart. (Map 10.)

ZARIA : Kaduna. PLATEAU : Gindiri. OYO : Oshogbo, Ibadan. ONDO : Okitipupa. BENIN : Benin. WARRI : Forcados. COLONY : Lagos, Yaba, Epe. RIVERS : Ahoada, Bonny. CAMEROONS : Mamfe, Kumba. Also one from " N. Nigeria " (*Dr. Parsons*, 1912).

15. *Chrysops distinctipennis* Austen. (Map 11.)

SOKOTO : Yelwa. ILORIN : Bussa, Ilorin. NIGER : Kontagora, Zungeru. ZARIA : Kaduna, Shika, Kumbaka, R. Sarkin Pawa. BAUCHI : Gadau. OYO : Oyo.

16. *Chrysops langi* Bequaert. (Map 12.)

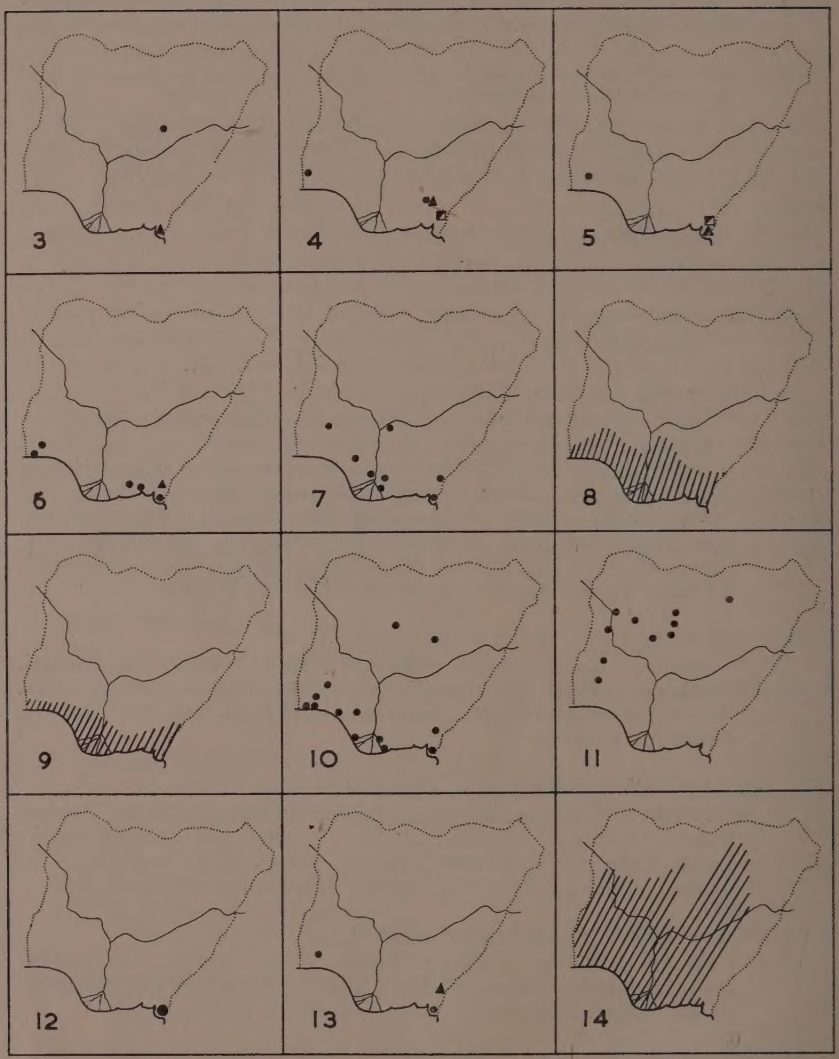
CAMEROONS : Kumba.

17. *Chrysops centurionis* Austen. (Map 12.)

CAMEROONS : Kumba.

18. *Chrysops maximus* Krober. (Map 12.)

CAMEROONS : Kumba (bred from larvae).



Maps. 3–14.—(3) ●, *Pangonia ruppellii* ; ▲, *Dasycompsa cincta*. (4) ●, *Subpangonia gravoti* ; ▲, *S. grahami* ; ◩, *Nuceria semilivida*. (5) ●, *Thriambeutes singularis* ; ▲, *Tabanocella praestabilis* ; ◩, *Thriambeutes nigripennis*. (6) ●, *Thaumastocera akwa* ; ▲, *Tabanocella schoutedeni*. (7) *Tabanocella stimulans*. (8) *Chrysops silacea*. (9) *Chrysops dimidiata*. (10) *Chrysops longicornis*. (11) *Chrysops distinctipennis*. (12) *Chrysops maximus*, *C. langi*, and *C. centurionis* ; these three species are known only from the single locality, Kumba, British Cameroons. (13) ●, *Chrysops griseicollis* ; ▲, *C. zahrai*. (14) *Ancala fasciata*.

19. *Chrysops griseicollis* Bequaert. (Map 13.)

Oyo : Ibadan (1 male). Cameroons : Kumba (bred from larvae), Njah-Etu. The male from Moor Plantation, Ibadan, was originally thought to be *Chrysops lanigera*.

20. *Chrysops zahrai* Oldroyd. (Map 13.)

Bamenda : Gwofon.

Sub-family : Tabaninae.

Tribe : Tabanini.

21. *Ancala fasciata* (Fabricius). (Map 14.)

Tabanus fasciatus Fabricius.

Both the typical form and the subspecies *nilotica* occur in Nigeria but it is not known to which form most of the records refer and so these are not segregated.

Ilorin : Ilorin, Bussa, Jebba, Pategi. Niger : Wushishi, Bokani, Baro. Zaria : Kaduna. Bauchi : Gadau, Azare, Darazo. Kabba : Etobe. Benue : Ibi, Amara, Shonga, Bukunji. Benin : Asaba, Ohere, Allah, Benin. Warri : Warri, Forcados, Aboh. Oyo : Ibadan, Oni River. Abeokuta : Opilifa. Colony : Lagos, Yaba, Badagri, Epe. Onitsha : Onitsha. Ogoja : Afikpo, Ikom, Obubra. Rivers : Ahoada, Degema. Calabar : Calabar, Oban, Uwet, Itu.

22. *Ancala africana* (Gray). (Map 15.)

Tabanus africanus Gray.

Bauchi : Gadau.

23. *Ancala latipes* (Macquart). (Map 16.)

Tabanus latipes Macquart.

Sokoto-Katsina : Pawa. S. Bornu. Ilorin : Ilorin, Mureji, Jebba. Niger : Baro, Wushishi, Bokani. Bauchi : Gadau, Katagum. Kabba : Lokoja. Benue : Between Amara and Ibi. Benin : Asaba.

24. *Ancala necopina* (Austen). (Map 15.)

Tabanus necopinus Austen.

S. Bornu. Bauchi : Gadau, Azare. Benue : Amageddi.

25. *Atylotus agrestis* (Wiedemann). (Map 17.)

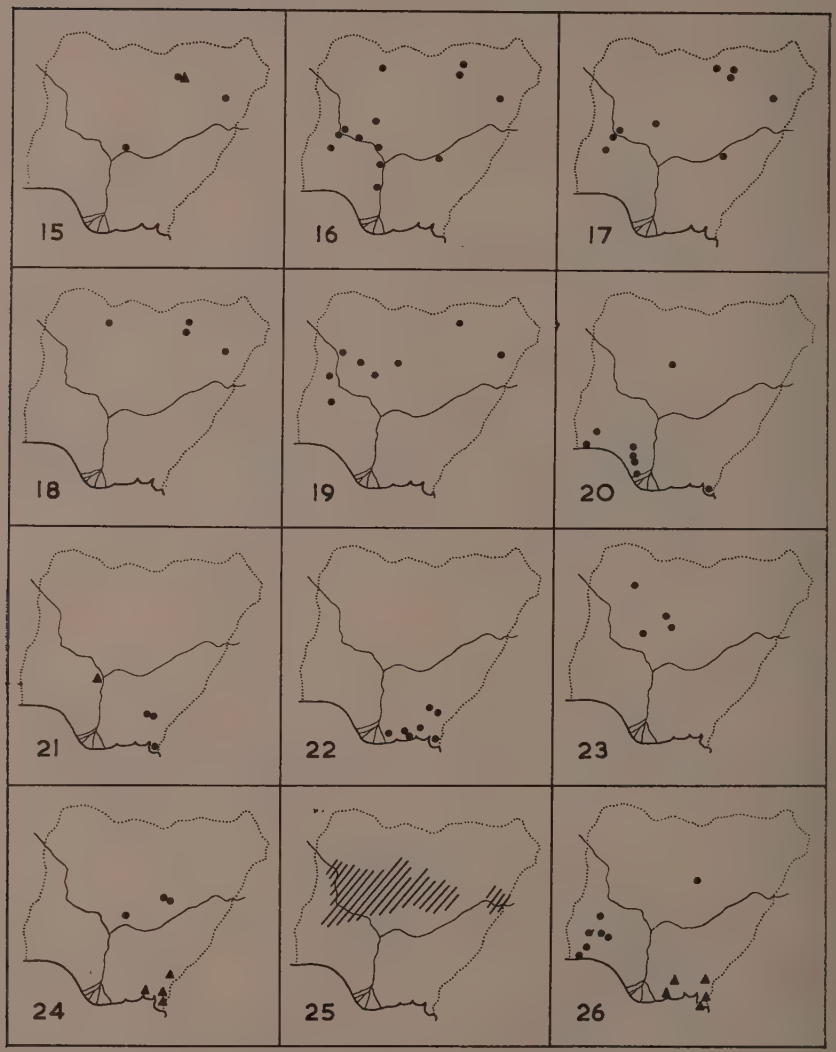
Tabanus ditaeniatus Macquart.

Kano : Hadeija. Bornu : Biu. Ilorin : Ilorin, Jebba. Niger : Zungeru, Bokani, Wushishi. Bauchi : Katagum, Gadau. Benue : between Amara and Ibi, Ibi. Also Kalkala (? Province).

26. *Atylotus fuscipes* (Ricardo). (Map 18.)

Tabanus fuscipes Ricardo.

S. Bornu : Biu. Katsina : Ruma. Bauchi : Katagum, Azare.



Maps 15–26.—(15) ●, *Ancala necopina*; ▲, *A. africana*. (16) *Ancala latipes*. (17) *Atylotus agrestis*. (18) *Atylotus fuscipes*. (19) *Atylotus albipalpus*. (20) *Tabanus billingtoni*. (21) ●, *Tabanus marmorosus*; ▲, *T. sufis*. (22) *Tabanus obscurefumatus*. (23) *Tabanus pertinens*. (24) ●, *Tabanus leucostomus*; ▲, *T. triquetrornatus*. (25) *Tabanus gratus*. (26) ●, *Tabanus pluto*; ▲, *T. argenteus*.

27. *Atylotus albipalpus* (Walker). (Map 19.)

Tabanus albipalpus Walker.

Sokoto : Yelwa. S. Bornu. Ilorin : Ilorin, Zungo. Niger : Kontagora, Bassa, Zungeru. Zaria : Kaduna. Bauchi : Katagum. Also Beri (? Niger or Zaria Province).

28. *Tabanus billingtoni* Newstead. (Map 20.)

Zaria : Kaduna. Oyo : Ibadan. Benin : Benin, Ohere, Ologbo. Warri : Warri, Sapele. Colony : Yaba. Cameroons : near Cameroons Mountain.

29. *Tabanus marmorosus* Surcouf. (Map 21.)

Ogoja : Obokum, Ikom. Cameroons : Kumba.

30. *Tabanus obscurefumatus* Surcouf. (Map 22.)

Ogoja : Ikom. Rivers : Degema. Calabar : Eket, Oban, Odut, Kwa-Ibo River. Cameroons : Mamfe, Liku, Kumba to Victoria road.

31. *Tabanus sufis* Jaennicke. (Map 21.)

Kabba : Lokoja. Also " Benue River " ?

32. *Tabanus pertinens* Austen. (Map 23.)

Sokoto : Anka. Niger : Zungeru. Zaria : Kaduna and " Southern Zaria." Also Benue River, exact location unknown.

33. *Tabanus leucostomus* Loew. (Map 24.)

Plateau : Amper, Dawaki (*Authors*). Benue : Nassarawa. In the French Cameroons, Marua and the Sanaga River.

34. *Tabanus gratus* Loew. (Map 25.)

Sokoto : Yelwa. Ilorin : Ilorin, Ropiya. Niger : Izom, Zungeru, Kontagora. Zaria : Kaduna, Shika, Kudaru, Babinda, Kateri, R. Sarkin Pawa. Plateau : Panyam, Pankshin, Amper, Shendam. Adamawa : Song, Yola. Also Ruka, R. Baka, Mirriam Kwolla, R. Benue (? Provinces).

35. *Tabanus triquetrornatus* Carter. (Map 24.)

Calabar : Calabar. Cameroons : Nguti ferry, Kumba. Bamenda : Gwofon.

36. *Tabanus argenteus* Surcouf. (Map 26.)

T. williamsi Austen.

Owerri : Benda. Calabar : Opobo. Cameroons : Mamfe, Kumba, Victoria.

37. *Tabanus niveinotatus* Bequaert. (Map 58.)

Ogoja: Ikom, Cross River.

38. *Tabanus pluto* Walker. (Map 26.)

ILORIN : Ilorin. PLATEAU : Vom. OYO : Oshogbo, Ibadan, Ilesha, Oyo. COLONY : Yaba, Agege. Also Benue River, exact locality unknown.

39. *Tabanus biguttatus* Wiedemann. (Map 27.)

SOKOTO : Jega. KANO : Dutsi. S. BORNU. ILORIN : Ilorin, Bussa, Jebba. NIGER : Bokani, Zungeru, Wushishi, Massamabu, Kontagora, Baro. ZARIA : Kaduna. BAUCHI : Azare. KABBA : Lokoja. BENUE : between Amara and Ibi. OYO : Oyo, Ibadan. COLONY : Lagos. OGOJA : Cross River.

40. *Tabanus aeneus* Surcouf. (Map 28.)

CAMEROONS : Kumba. BAMENDA : Gwofon.

41. *Tabanus ruficrus* Palisot de Beauvois. (Map 29.)

OYO : Ilesha. COLONY : Yaba. OGOJA : Ikom, Obubra, Obokum. CAMEROONS : Mamfe.

42. *Tabanus brumpti* Surcouf. (Map 28.)

BENUE : Ibi.

43. *Tabanus donaldsoni* Carter. (Map 28.)

CALABAR : Calabar.

44. *Tabanus scholae* Oldroyd. (Map 29.)

CAMEROONS : Kumba.

45. *Tabanus par* Walker. (Map 30.)

SOKOTO : Dongwam, Ka River. KANO : Birnin Kudu. BORNU : Lake Chad, Biu. ILORIN : Ilorin, Dumaji, Jebba. NIGER : Zungeru, Wushishi, Baro, Bokani. ZARIA : Katabu. ADAMAWA : Yola. BENUE : Katsina Ala, Ibi, Amara. WARRI : Warri, Forcados. COLONY : Badagri, Lagos, Yaba. OWERRI : Bende. CAMEROONS : Mamfe.

46. *Tabanus thoracinus* Palisŏt de Beauvois. (Map 31.)

NIGER : Baro, Zungeru. ZARIA : Kaduna, Katabu, Kudaru, Shika. PLATEAU : Alizaga. KABBA : Lokoja. OYO : Ibadan, Ikirun, Oni. BENIN : Benin, Ologbo. WARRI : Burutu, Forcados, Warri, Sapele. ABEOKUTA : Ilaro. COLONY : Lagos, Epe, Badagri, Yaba. ONITSHA : Oji River. OGOJA : Afikpo, Obubra, Ikom. RIVERS : Brass, Degema, Bonny, Akassa. CALABAR : Calabar, Itu, Ikot-Ekpene, Opobo.

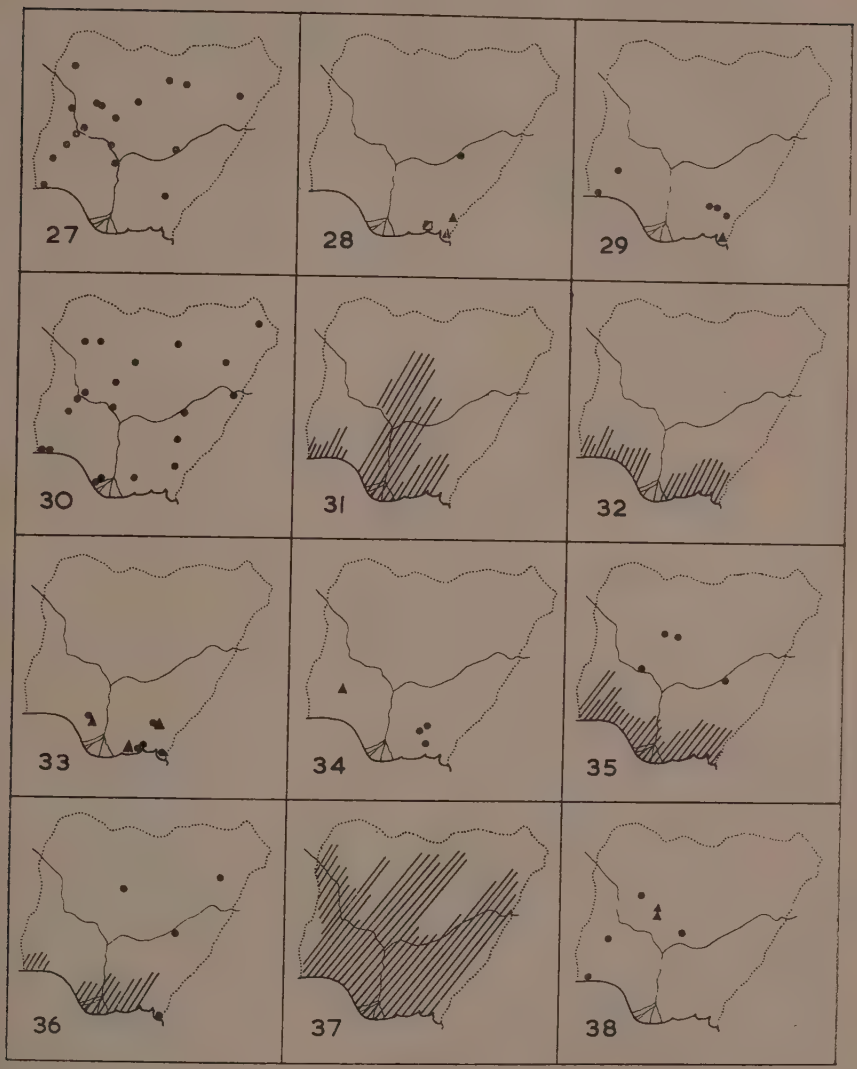
47. *Tabanus besti* Surcouf. (Map 32.)

T. obscurissimus Ricardo.

OYO : Ilesha. ONDO : Ifon, Agbabu. BENIN : Benin. ABEOKUTA : Ilaro. COLONY : Badagri, Epe. OGOJA : Ikom, Obokum, Obubra, Afikpo. OWERRI : Bende. CALABAR : Calabar, Uwet, Itu. CAMEROONS : Kumba. BAMENDA : Gwofon.

48. *Tabanus lubutuensis* Bequaert. (Map 33.)

BENIN : Benin. OGOJA : Cross River. CALABAR : Opobo.



Maps 27–38.—(27) *Tabanus biguttatus.* (28) ●, *Tabanus brumpti;* ▲, *T. aeneus;* ◩, *T. donaldsoni.* (29) ●, *Tabanus ruficrus;* ▲, *T. scholae.* (30) *Tabanus par.* (31) *Tabanus thoracinus.* (32) *T. besti.* (33) ●, *T. obscurehirtus;* ▲, *T. lubutuensis.* (34) ●, *T. combustus;* ▲, *T. quadrisignatus.* (35) *Tabanus secedens.* (36) *T. conformis.* (37) *T. taeniola.* (38) ●, *T. laverani;* ▲, *T. sugens.*

On maps 35 and 36 the cross-hatching indicates the general area of the species and the circles indicate isolated records outside this area.

49. *Tabanus obscurehirtus* Ricardo. (Map 33.)

BENIN : Benin. OGOJA : Ikom, Obubra. OWERRI : Akwete. CALABAR : Eket, Cross River. CAMEROONS : Kumba, Ekona.

50. *Tabanus combustus* Bigot. (Map 34.)

OGOJA : Ediba, Afikpo, Obubra. These records are from Simpson (1912*a*), but we have seen no specimens of this species ourselves from Nigeria. Some specimens of *Tabanus* from Calabar stood under this name in the British Museum Collection for some years, but these, on examination, proved to be *T. conformis* (Oldroyd, 1954 : 255).

51. *Tabanus secedens* Walker. (Map 35.)

T. kingsleyi Ricardo.
T. regnaulti Surcouf.

ILORIN : Ilorin, Mureji. ZARIA : Kaduna, Koriga. BENUE : Ibi. OYO : Ibadan, Ilesha. ONDO : Okitipupa. BENIN : Benin, Ologbo, Asaba, Ohere. WARRI : Aboh, Warri, Forcados. COLONY : Lagos, Yaba, Badagri, Epe. OGOJA : Afikpo, Ikom, Obubra, Obokum. OWERRI : Okigwi, Akwete, Ishiago, Bende. RIVERS : Ahoada, Brass, Degema, Akassa. CALABAR : Calabar, Eket, Itu, Opobo, Uwet. CAMEROONS : Mamfe, Kumba. BAMENDA : Bamenda, Gwofon.

52. *Tabanus quadrisignatus* Ricardo. (Map 34.)

OYO : Oshogbo.

53. *Tabanus simpsoni* Austen. (Map 59.)

ILORIN : Ilorin, Offa.

54. *Tabanus conformis* Walker. (Map 36.)

T. socialis Walker.

S. BORNU. ZARIA : Kaduna. BENUE : Ibi. OYO : Ibadan. WARRI : Warri, Forcados, Aboh, Sapele. ABEOKUTA : Olokomeji. COLONY : Lagos, Epe, Badagri. ONITSHA : Onitsha. OGOJA : Afikpo, Obokum. OWERRI : Owerri, Akwete. RIVERS : Bonny, Degema, Ahoada, Brass, Akassa. CALABAR : Calabar, Eket, Opobo, Itu. CAMEROONS : Cameroons Mountain.

55. *Tabanus longinquus* Oldroyd. (Map 58.)

NIGER : Zungeru. ZARIA : Dinya, R. Sarkin Pawa. KABBA : Lokoja. BENUE : Benue River, Abinsi. OYO : Oshogbo. Also Afumatan, S. Nigeria (? province).

56. *Tabanus flavicoxa* Oldroyd. (Map 59.)

OYO : Oshogbo, Ilesha.

57. *Tabanus fuscipleuris* Oldroyd. (Map 59.)

COLONY : near Lagos. CAMEROONS : Mamu.

58. *Tabanus taeniola* Palisot de Beauvois. (Map 37.)

T. sagittarius Macquart.
T. variatus Walker.

Sokoto : Yelwa, Jega, Aida, Jambarko, Boko, Kawara-Rahayi. Katsina : Pawa. Kano : Kano, Sintilmawa. S. Bornu. Ilorin : Ilorin, Mureji, Jebba. Niger : Zuru, Zungeru, Wushishi, Minna, Baro, Bajibo. Zaria : Kaduna, Katabu. Plateau : Jemaa. Bauchi : Gadau, Katagum. Adamawa : Banjiram, Yola. Kabba : Lokoja, Umaisha to Bagana. Benue : Ibi, Abinsi, Keffi. Oyo : Ibadan, Oshogbo, Oyo. Warri : Warri, Forcados, Aboh. Abeokuta : Ilaro, Opilifa, Olokomeji. Colony : Badagri, Lagos, Yaba, Agege. Ogoja : Afikpo, Abakaliki, Obubra, Ikom. Owerri : Bende. Calabar : Calabar, Opobo, Itu. Cameroons : Mamfe. Also Hadjer-el-Hamis, on the edge of Lake Chad, just in French territory, and Loko (? province).

59. *Tabanus sugens* Wiedemann. (Map 39.)

Niger : Zungeru, Tegina to Kagara.

60. *Tabanus laverani* Surcouf. (Map 38.)

Ilorin : Ilorin. Niger : Kontagora. Benue : Massarawa. Colony : Yaba.

61. *Tabanus subangustus* Ricardo. (Map 39.)

Sokoto : Yelwa. Kano : Kano. Ilorin : Ilorin, Offa. Niger : Kontagora, Baro, Zungeru, Tegina. Zaria : Zaria, Kaduna, Katabu, Rigachikun, Gamagira, Kudaru. Bauchi : Bauchi. Adamawa : Yola. Benue : Shonga, Amara, Ibi. Oyo : Ibadan, Oshogbo. Benin : Allah. Abeokuta : Ilaro, Meko. Colony : Lagos. Also Usai, Abutshi, Odut (?? Provinces).

62. *Tabanus nyasae* Ricardo. (Map 40.)

Sokoto : Chafe. Kano : Dadin Kowa, Mallam Awa, Kogin Kano. Ilorin : Share. Niger : Abuja, Zungeru. Zaria : R. Sarkin Pawa, Wuya, Kudaru, Babinda, Katabu, Mando, Zaria to Kaduna road, Shika. Plateau : Amper, Dawaki, Pankshin, Shendam, Gindiri.

63. *Tabanus severini* Surcouf. (Map 41.)

Calabar : Kwa-Ibo River.

64. *Tabanus chevalieri* Surcouf. (Map 41.)

Niger : Zungeru. Zaria : Wuya. Also " R. Benue ", exact locality unknown.

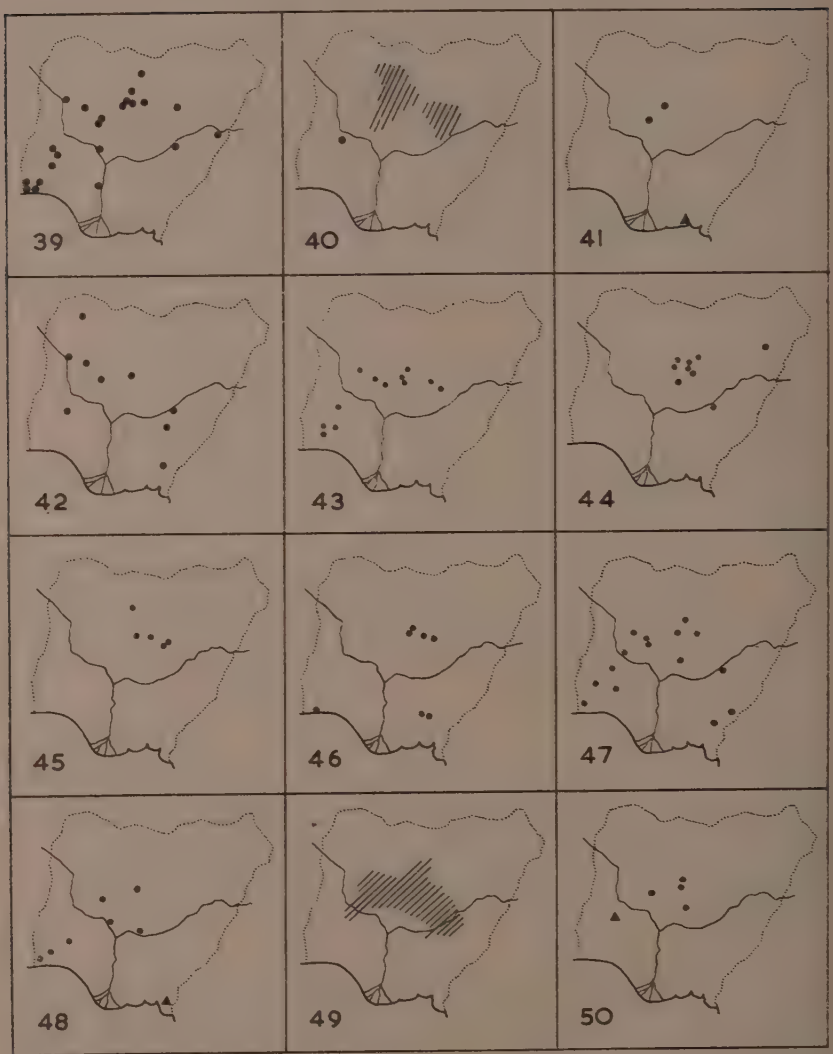
Tribe : Haematopotini.

65. *Haematopota beringeri* Austen. (Map 57.)

Kabba : Lokoja.

66. *Haematopota pertinens* Austen. (Map 44.)

Kano : Doguwan Giginia. S. Bornu. Zaria : Kaduna, Kudaru Lere, Allowa, Katabu. Plateau : Ancho. Bauchi : Rishi.



Maps 39–50.—(39) *Tabanus subangustus*. (40) *T. nyasae*. (41) ●, *T. chevalieri*; ▲, *T. severini*. (42) *Haematopota bullatifrons*. (43) *Haematopota decora*. (44) *H. pertinens*. (45) *H. patellicorne*. (46) *H. guineensis*. (47) *Haematopota lacessens*. (48) ●, *H. tenuicrus*; ▲, *H. crewei*. (49) *H. pallidipennis*. (50) ●, *H. gracilis*; ▲, *H. hastata*.

On map 40 the cross-hatching indicates the general area of the species and the circle indicates isolated records outside this area.

67. *Haematopota bullatifrons* Austen. (Map 42.)

SOKOTO : Sokoto, Yelwa. ILORIN : Ilorin. NIGER : Kontagora, Zungeru, Wushishi. ZARIA : Kaduna. BENUE : Katsina Ala, Ibi. CAMEROONS : Mamfe. Also Marka (? BORNU).

68. *Haematopota griseicoxa* Oldroyd. (Map 52.)

CAMEROONS : Kumba.

69. *Haematopota horrida* Oldroyd. (No map.)

One specimen in the B.M. collection labelled "Southern Nigeria" and collected by A. W. J. Pomeroy.

70. *Haematopota crewei* Oldroyd. (Map 48.)

CAMEROONS : Mungo River between Kumba and Nguti, Mamfe, Kembong, Kumba Mukonje, Kumba to Nguti road.

71. *Haematopota barombi* Oldroyd. (Map 53.)

CAMEROONS : Kumba.

72. *Haematopota guineensis* Bigot. (Map 46.)

H. cordigera Bigot.

ZARIA : Kaduna, Katabu. PLATEAU : Gindiri. OGOJA : Ikom, Obubra. COLONY : Lagos. Also Niger Province (?).

73. *Haematopota angustifrons* Carter. (Map 57.)

H. pallidicornis Edwards.

CALABAR : Ikot-Ubo. Also Cross River, exact locality not known.

74. *Haematopota bantuana* Oldroyd. (Map 52.)

OYO : Ilesha to Oshogbo road. CALABAR : Oban.

75. *Haematopota hastata* Austen. (Map 50.)

ILORIN : Ilorin. NIGER : Minna (♂), Egpenimi. Also R. Aunwa between Moma and Agodi (?? BENUE PROVINCE).

76. *Haematopota abyssinica* Surcouf. (Map 51.)

H. puniens Austen.

S. BORNU. NIGER : Kontagora area. ZARIA : Kaduna, Katabu, Zaria, Little Koriga River, Garun Gwanki. BAUCHI : Katagum, Gadau. CAMEROONS : Bansa. BAMENDA : Kishong.

77. *Haematopota gracilis* Austen. (Map 50.)

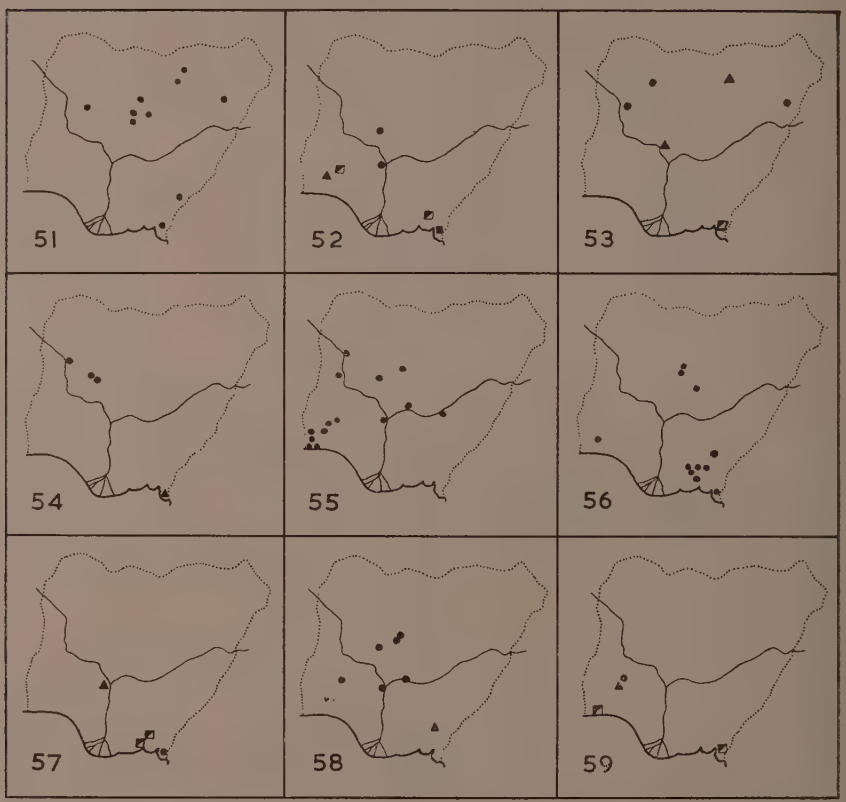
NIGER : Wushishi. ZARIA : Kaduna, Little Koriga River. BENUE : Keffi.

78. *Haematopota tenuis* Austen. (Map 53.)

SOKOTO PROVINCE, exact locality not known. NIGER : Baro. BAUCHI : Gadau.

79. *Haematopota decora* Walker. (Map 43.)

ILORIN: Ilorin. NIGER: Zungeru, Kontagora, Minna. ZARIA: Kaduna, Wuya, R. Sarkin Pawa. PLATEAU: Amper, Gindiri. OYO: Oshogbo, Ibadan, Oyo.



MAPS 51–59.—(51) *Haematopota abyssinica*. (52) ●, *H. exiguicornuta*; ▲, *H. albihirta*; ◩, *H. bantuana*; ■, *H. griseicoxa*. (53) ●, *H. pinguicornis*; ▲, *H. tenuis*; ◩ *H. barombi*. (54) ●, *H. corsoni*; ▲, *H. heptagramma*. (55) *Hippocentrum versicolor*; (56) *Hippocentrum strigipenne*. (57) ●, *Hippocentrum concisum*; ▲, *Haematopota beringeri*; ◩, *Haematopota angustifrons*. (58) ●, *Tabanus longinquus*; ▲, *T. niveinotatus*. (59) ●, *T. simpsoni*; ▲, *T. flavicoxa*; ◩, *T. fuscipleuris*.

80. *Haematopota patellicorne* Enderlein. (Map 45.)

H. vittata (*northern form*) Oldroyd.

KATSINA: Pawa. ZARIA: Kaduna, Kudaru. PLATEAU: Gindiri, Mongun Arna.

81. *Haematopota albihirta* Karsch. (Map 52.)

H. mactans Austen.

Oyo : Ibadan. There are no Nigerian specimens of this species in the British Museum collection and there is some doubt as to the validity of this record. It is given by Golding (1946).

82. *Haematopota pinguicornis* Carter. (Map 53.)

Sokoto : Bagega. Niger : Ipana. Adamawa : Pella, Dua.

83. *Haematopota exiguicornuta* Carter. (Map 52.)

Niger : Zungeru. Kabba : Lokoja.

84. *Haematopota corsoni* Carter. (Map 54.)

Sokoto : Bin Yauri. Niger : Anaba, Mariga, Bobi.

85. *Haematopota tenuicrus* Austen. (Map 48.)

Niger : Baro, Zungeru. Zaria : Kaduna. Benue : Akwatta. Oyo : Oshogbo. Abeokuta : Ilaro, Olokomeji.

86. *Haematopota heptagramma* Speiser. (Map 54.)

Cameroons : Cameroons Mountain, Soppo near Buea.

87. *Haematopota pallidipennis* Austen. (Map 49.)

Kano : Birnin Kudu, Dadin Kowa, Kibiya. Ilorin : Ilorin. Niger : Minna, Guni, Izom, Paiko, Gurara Falls, Bajibo, Kontagora, Zungeru. Zaria : Kaduna, Zaria, R. Sarkin Pawa, Kudaru, Babinda, Gimi, Shika and other localities in the south-west of the province. Plateau : Zagun, Bukuru, Pankshin, Panyam, Dawaki, Amper, Gindiri. Kabba : Iya. Benue : Ibi, Wukari.

88. *Haematopota lacessens* Austen. (Map 47.)

Ilorin : Ilorin. Niger : Kontagora, Zungeru, Bokani, Wushishi, Mariga. Zaria : Kaduna, Zaria, Kudaru, Allowa. Benue : Keffi, Ibi. Oyo : Ilesha, Oyo. Abeokuta : Ilaro. Cameroons : Mamfe. Also Konoko (? Province), and ?? Oku hills (Bamenda).

89. *Hippocentrum versicolor* Austen. (Map 55.)

Sokoto : Yelwa. Ilorin : Zali, Offa, Ilorin. Niger : Zungeru, Wushishi, Tegina. Zaria : Kaduna, Little Koriga River. Kabba : Lokoja. Benue : Ibi, Akwatta. Oyo : Oyo, Oshogbo, Ibadan, Ilesha. Abeokuta : Ilaro, Meko, Olokomeji. Colony : Lagos, Yaba, Badagri.

90. *Hippocentrum strigipenne* Karsch. (Map 56.)

H. trimaculatum Newstead.

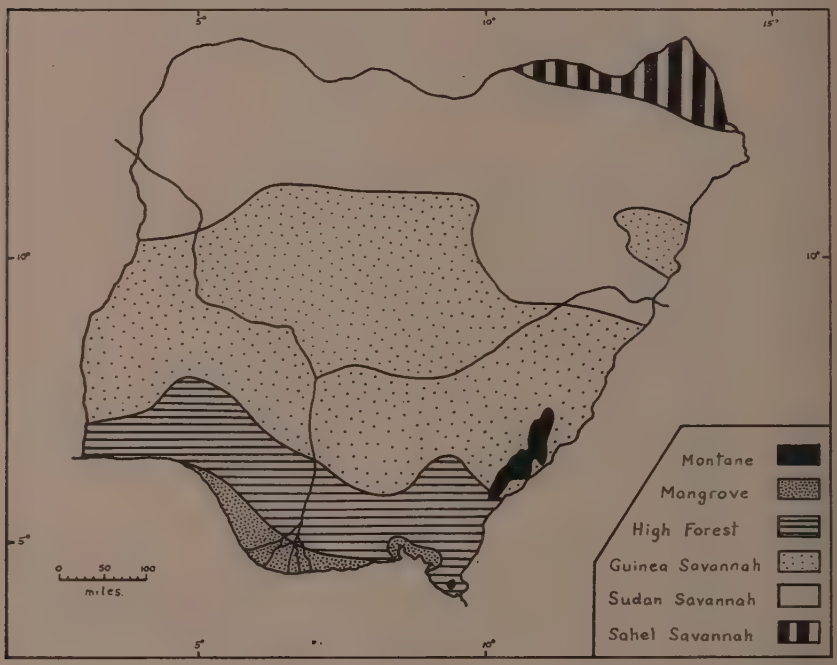
Zaria : Kaduna, Rigachikun, Katabu. Plateau : Jemaa. Oyo : Agbede. Ogoja : Afikpo, Obudu, Ikom, Eke-Ada. Owerri : Bende, Okigwi. Calabar : Itu. Cameroons : Kumba.

91. *Hippocentrum concisum* Speiser. (Map 57.)

Cameroons : Buea, Mt. Cameroon.

Oldroyd considers that this form may in fact be no more than a variety of *H. strigipenne*.

Connal (1928) recorded *Tabanus diurnus* Walker (now *Atylotus diurnus*) from Nigeria, but it seems almost certain that this was due to mis-identification. *A. diurnus* is known only from a single specimen from the Cape of Good Hope, and there appears to be some doubt of validity of the locality label. The Pangonine fly *Hinea rodhaini* Bequaert is known from the Gold Coast and from the French Cameroons, so it seems probable that it will in due course be discovered in Nigeria.



MAP 60.

Map 60.—Vegetation map of Nigeria and the British Cameroons. (Based on Rosevear, 1953.)

(b) Relation to Vegetation.

The vegetation of Nigeria has been well described by Keay (1949) and by Rosevear (1953); the recent work of Rosevear has modified earlier vegetation maps, particularly with regard to the southern limit of the Sudan Savannah. Map 60 shows the six main floral areas into which Rosevear divides the country.

The relation of Tabanidae to their vegetation habitats has been very little studied, such work as has been done being confined to *Chrysops* as this genus is by far the most important from the medical point of view. It seems reasonable to suppose that, for a number of species at any rate, a definite connection must exist between distribution and vegetation; we have therefore tabulated on

p. 362 each species in relation to the vegetation zones from which it has been recorded. In addition we give below a brief description of each vegetation zone together with an indication of the species which appear to be characteristic of those zones. In many cases species appear to be confined to one zone only, but the fewness of the records makes it impossible to draw any hard and fast conclusions. On the other hand, some species roam far and wide over Nigeria from the mangrove swamps to the Sudan savannah, e.g. *Ancala fasciata*, *Tabanus taeniola* and *T. par*, the latter extending to the Sahel savannah of the far north-east. In the Cameroons rain-forest a number of species, such as *Nuceria semilivida*, *Dasycompsa cincta* and *Chrysops centurionis*, have been found which are intruders from the rain-forest areas of the south-east.

Recently it has been recognised that distribution may be determined not only by the type of botanical association, but also by the height of the leaf canopies within each zone ; this has been studied particularly by Haddow and others (1950) and by Haddow (1952) in Uganda, but evidence is accumulating that there may be a vertical zonation of *Chrysops* species in the Cameroons. The smallness of the number of records of some southern Nigerian Tabanids may be due to the fact that the flies are normally dwellers in the high tree-tops, and seldom come to man.

Mangrove swamps.—These are confined to the coastal creeks and the Niger delta and are characterised by the dominant Red Mangrove (*Rhizophora* sp). The land is perennially inundated with brackish water. The species *Ancala fasciata*, *Tabanus conformis*, *T. secedens* and *T. taeniola* are common in the Mangrove zone and will viciously attack persons on canoes and other vessels plying in the creeks. *Chrysops silacea* is also common in the zone, but the only *Haematopota* known from this region is *H. angustifrons*. Two species, *Tabanus donaldsoni* and *T. severini*, are known from no other vegetation zone.

High Forest.—A true forest formation of tall trees up to 150 ft. in height and providing continuous cover over the ground, with a leafy canopy generally at about 100 ft. In the more northerly part of the zone the forest is dry, but in the Cameroons the forest floor is wet: this forest, together with that in Benin Province, is often spoken of as Rain-Forest or Tropical Rain-Forest. Many species of Tabanids are known only from the High Forest of the Cameroons, particularly certain forest *Haematopota* and *Chrysops*. The most characteristic species of the High Forest are : *Chrysops silacea*, *C. dimidiata*, *Tabanus secedens*, *T. besti*, *T. obscurefumatus* and *T. obscurehirtus*. The genera *Subpangonia*, *Tabanocella*, *Thaumastocera*, *Thriambeutes*, *Nuceria* and *Dasycompsa* appear from the records available to be almost confined to the High Forest zone.

Over three-quarters of the area of Nigeria is savannah country, characterised by a continuous grassy cover with small branching trees, the latter only rarely large and leafy enough to provide a continuous canopy. Many species are confined to the savannah, and, with the exception of a few Cameroonian species, the genus *Haematopota* may be regarded as characteristic of the savannah lands.

Guinea Savannah.—This zone lies immediately to the north of the High Forest and extends over the greater part of Nigeria. Trees are small, seldom over 40 ft. in height, standing some 10–30 ft. apart, and providing little shade from the small crowns. The grass is generally from 5 ft. to 8 ft. high and is burnt annually. Many species of *Haematopota* are known only from the Guinea Savannah and *H. decora*, *H. lacessens*, *H. pertinens* and *H. pallidipennis* are

TABLE I.—*Table showing the distribution of the Nigerian Tabanidae according to vegetation zones.*

(The Montane zone is omitted as no species are known from it; the Sahel Savannah is omitted as only *Atylotus agrestis* and *Tabanus par* are known from this zone.)

Species.	Mangrove.	High Forest.	Guinea Savannah.	Sudan Savannah.
Dasycompsa cincta	.	×	.	.
Pangonia rüppellii	.	.	×	× ?
Nuceria semilivida	.	×	× ?	.
Subpangonia gravoti	.	×	×	.
S. grahami	.	×	.	.
Thriambeutes singularis	.	×	.	.
T. nigripennis	.	×	.	.
Thaumastocera akwa	×	×	.	.
Tabanocella stimulans	×	×	×	.
T. schoutedeni	.	×	.	.
T. praestabilis	.	×	.	.
Chrysops silacea	×	×	×	.
C. dimidiata	×	×	.	.
C. longicornis	×	×	×	.
C. distinctipennis	.	.	×	×
C. langi	.	×	.	.
C. centurionis	.	×	.	.
C. maximus	.	×	.	.
C. griseicollis	.	×	.	.
C. zahrai	.	× ?	× ?	.
Ancala fasciata	×	×	×	×
A. africana	.	.	.	×
A. latipes	.	×	×	×
A. necopina	.	.	×	×
Atylotus agrestis	.	.	×	×
A. fuscipes	.	.	.	×
A. albipalpus	.	.	×	×
Tabanus billingtoni	×	×	×	.
T. marmorosus	.	×	.	.
T. obscurefumatus	×	×	.	.
T. sufis	.	.	×	.
T. pertinens	.	.	×	×
T. leucostomus	.	.	×	.
T. gratus	.	.	×	×
T. triquetrornatus	×	×	× ?	.
T. argenteus	×	×	.	.
T. niveinotatus	.	×	× ?	.
T. pluto	.	×	×	.
T. biguttatus	.	×	×	×
T. aeneus	.	×	× ?	.
T. ruficrus	.	×	.	.
T. brumpti	.	.	×	.
T. donaldsoni	×	.	.	.
T. scholae	.	×	.	.
T. par	×	×	×	×
T. thoracinus	×	×	×	.
T. besti	×	×	.	.
T. lubutuensis	.	×	.	.
T. obscurehirtus	×	×	.	.
T. combustus	.	×	.	.
T. secedens	×	×	×	.

TABLE I (*continued*).

Species.	Mangrove.	High Forest.	Guinea Savannah.	Sudan Savannah.
T. quadrisignatus	.	×	.	.
T. simpsoni	.	× ?	× ?	.
T. conformis	×	×	×	.
T. longinquus	.	×	×	.
T. flavicoxa	.	×	.	.
T. fuscipleuris	.	×	.	.
T. taeniola	×	×	×	×
T. sugens	.	.	×	.
T. laverani	.	×	×	.
T. subangustus	.	×	×	×
T. nyasae	.	.	×	×
T. severini	×	.	.	.
T. chevalieri	.	.	×	.
Haematopota beringeri	.	.	×	.
H. pertinens	.	.	×	.
H. bullatifrons	.	×	×	×
H. griseicoxa	.	×	.	.
H. horrida	.	× ?	.	.
H. crewei	.	×	.	.
H. barombi	.	×	.	.
H. guineenis	.	×	×	.
H. angustifrons	×	×	.	.
H. bantuana	.	×	.	.
H. hastata	.	.	×	.
H. abyssinica	.	×	×	×
H. gracilis	.	.	×	.
H. tenuis	.	.	×	×
H. decora	.	.	×	.
H. patellicorne	.	.	×	.
H. albihirta	.	×	.	.
H. pinguicornis	.	.	×	×
H. exiguicornuta	.	.	×	.
H. corsoni	.	.	×	×
H. tenuicrus	.	×	×	.
H. heptagramma	.	×	.	.
H. pallidipennis	.	.	×	×
H. lacessens	.	×	×	.
Hippocentrum versicolor	.	×	×	×
H. strigipenne	.	×	×	.
H. concisum	.	×	.	.

characteristic. *Chrysops distinctipennis*, *Tabanus subangustus*, *T. nyasae* and *T. gratus* may also be regarded as characteristic.

Sudan Savannah.—This zone occupies over one-third of the area of Nigeria and lies to the north of the Guinea Savannah ; except in Bornu Province it stretches to the northern border of Nigeria. Trees tend to be smaller, sparser, and even less shady than in the Guinea Savannah and thorny species with pinnate leaves become common. The grass is generally shorter than five feet and most of the land has been disturbed by farming. Some twenty-two species are known from this zone, but only *Ancala africana* and *Atylotus fuscipes* are known from no other vegetation zone.

Sahel Savannah.—The vegetation is very sparse and tree growth confined

to the flat-topped *Acacia raddiana* and the shrub *Commiphora africana*. Grass cover is very short and never exceeds 3 ft. in height ; the land is almost entirely sand. The zone occupies a small area to the west of Lake Chad in northern Bornu Province. Only *Atylotus agrestis* and *Tabanus par* are definitely known from the zone, but there is little doubt that *T. taeniola* occurs and probably many other species as lay reports say that horse-flies are super-abundant in the Lake Chad area in the wet-season, being vicious biters of camels and other stock.

Montane.—This upland formation is represented only by Cameroon Mountain and the uplands of Bamenda and southern Adamawa Provinces. On Cameroons Mountain above about 3000 ft. the High Forest changes in character and tree-ferns, lichens and mosses make their appearance. In the Bamenda Highlands the true montane begins about 5000 ft. above sea-level and comprises rolling grass covered hills, the tree fern belt of Cameroons Mountain being unrepresented. Rosevear describes these areas as floral islands, Cameroon Mountain being related to Fernando Po and the the Bamenda Highlands more closely connected with East Africa. No species of Tabanidae are known from the Nigerian and Cameroonian montane areas ; *Hippocentrum concisum* and *Haematopota heptagramma* are species taken only at Soppo, near Buea, Cameroons Mountain, but this locality lies at only 2500 ft. well below the montane limit and within the High Forest zone. Much of the Bauchi Plateau in north central Nigeria lies over 4000 ft.; Rosevear suggests that this region is not truly montane although numbers of high altitude plants make their appearance here.

5. Bionomics.

(a) Immature Stages and Breeding Sites.

Very little is known of the pre-imaginal stages of any of the Nigerian Tabanidae. Some account of the larvae and pupae of certain species occurring in Nigeria has been given by King (1926) in the case of *Ancala fasciata nilotica*, and Lamborn (1929, 1930) and Nieschulz (1933) for *Tabanus biguttatus*. Lamborn (1938) has also given some information on the larva and pupa of *Tabanus taeniola*. Although King's and Lamborn's observations were made in the Sudan and Nyasaland respectively, it is probable that the behaviour of these species is similar in Nigeria. According to King, in the Sudan the larvae of *A. fasciata nilotica* are aquatic, and he found them attached to the leaf bases of the Water lettuce *Pistia stratiotes* in the White Nile. Lamborn gave an account of how the larvae of *T. biguttatus* and *T. taeniola* construct mud cylinders for the protection of the puparia from exposure when the mud cracks on the advent of the dry season.

Recently much work has been done in Nigeria on the early stages of *Chrysops silacea* and *C. dimidiata*, as well as on other species of *Chrysops* which have only come to light because of pupal collections. The breeding-places of *Chrysops* have been described by Chwatt and others (1948), and Gordon and others (1948). They found that in the Cameroons the larvae and pupae of *Chrysops* existed in the wet mud under dead leaves on the forest floor. In these situations they found also the immature stages of a number of unidentified species of *Tabanus* and *Haematopota*.

Some further information on *Chrysops* breeding has been provided by Davey and O'Rourke (1951*c*), who found the larvae and pupae at Benin in similar situations to those found by Gordon, Chwatt and Jones in the Cameroons. The favoured sites were in wet mud of swampy river banks, especially where there was much decaying matter and dense shade. Larvae were generally not found below a depth of three inches. Davey and O'Rourke record also the finding of larvae and pupae of *Tabanocella stimulans* and *Tabanus obscurehirtus* at Benin ; larvae of both species were obtained in the wet-season from July to October, while larvae of *Tabanocella* were found also in November. Davey and O'Rourke give tables of the duration of larval and pupal life : in one case a larvae of *T. obscurehirtus* lived for 124 days after collection, which the authors considered might indicate a diapause in the larval stage. They give the duration of pupal life as 10–12 days in the case of *T. stimulans*, and 9–13 days for *T. obscurehirtus*.

In Northern Nigeria many species of Tabanids are only in evidence as imagines during the wet-season months, and are almost entirely absent throughout the dry-season ; it seems probable that some diapause in one of the immature stages must take place to ensure survival through the extreme desiccation of the hot dry-season. During the dry-season most rivers dry completely or at least are reduced to scattered pools, the earth cracks, and much of the surface of the soil is eroded as dust by the north-east Harmattan wind. The mechanism of the mud-cylinders described by Lamborn probably takes place in Nigeria, and suggests that dry-season survival is maintained in the pupal stage.

(b) Habits of the Adult.

Feeding Habits.

So far as is known the blood-sucking females of Nigerian Tabanidae are entirely diurnal in their feeding-habits, although there is a possibility of some species of *Chrysops* being crepuscular. No night-biting species are known, although Haddow and others (1950) record nocturnal feeders in Uganda. Some species of *Chrysops* have recently been studied in some detail in the Cameroons and at Benin with regard to biting activity and the influence of meteorological conditions upon biting behaviour. Some information of *Chrysops silacea* and *C. dimidiata* is given in the papers of Gordon and others (1948), Crewe and O'Rourke (1951), Davey and O'Rourke (1951*a*, *b*), Kettle (1953) and Crewe (1953). Crewe and O'Rourke give some notes also on the biting activity of *C. langi*.

Probably the majority of Tabanid species are man-biters at times, and indeed some species are of considerable nuisance value, especially in the wet-season. In the case of *Tabanus* the approach to bite is usually audible, but the species of *Haematopota* attack silently and one is not aware of their presence until the mouthparts are being inserted. Golding (1946) listed 18 species of Tabanids as definitely known to attack livestock in Nigeria. It is known that horses are attacked by *Haematopota bullatifrons*, *H. pallidipennis*, *H. decora*, *Hippocentrum versicolor*, *Chrysops longicornis*, *C. distinctipennis*, *Atylotus agrestis*, *A. albipalpus* and *Tabanus taeniola ;* cattle are attacked by *H. decora*, *H. pallidipennis*, *H. guineensis*, *C. longicornis*, *C. distinctipennis*, *Tabanus subangustus*, *T. taeniola*, *T. nyasae*, *T. leucostomus*, *T. biguttatus* and *Pangonia rüppellii*. Donkeys we have seen attacked by *Tabanus nyasae* and *Haematopota pallidipennis*, and dogs by *H. abyssinica* and *H. pertinens*.

There are no records of Nigerian Tabanidae feeding upon game, but as game is so scarce in the country it seems improbable that game blood supports much of the Tabanid population. It is well known, however, that in the far north of the country Tabanidae are particularly vicious feeders on camels, which may be driven almost frantic by the attentions of these insects. It is not known what species are responsible for these attacks, but *Tabanus taeniola* and *T. par* are probably the most important.

We have noticed *Haematopota pertinens* apparently feeding on water from pools in the ruts of roads in the wet-season, while this species is attracted to, and appears to feed upon, wet mud clinging to the wheels and underparts of lorries. In 1911, in Ilorin, Dr. Scott-Macfie noticed the attraction of various species of Tabanids to the scale-insects (*Ceroplastes* sp.) on a chediya tree (*Ficus* sp.) in his compound. Apparently both males and females were attracted to the tree, but took no notice of a pony tethered nearby (recorded in 1912, *Bull. ent. Res.* **3** : 223–224).

The influence of meteorological conditions upon the feeding activity of Tabanidae has been studied by Crewe and O'Rourke (1951) for *Chrysops* in the Cameroons, by Davey and O'Rourke (1951*a*) at Benin, and by Crewe (1953) and Kettle (1953), also in the Cameroons. These authors give some information on the effect of temperature, humidity, light intensity and mean monthly rainfall upon the numbers of feeding *C. silacea* and *C. dimidiata*. Crewe and O'Rourke record a definite biting cycle with peaks in the morning and afternoon ; biting activity increases with rise of temperature but diminishes with rise of relative humidity. Kettle, working from Crewe and O'Rourke's findings, shows that this periodicity in biting probably bears some relation to the light intensity changes at the catching station used (Kaki Gorge, Kumba, British Cameroons), although Crewe (1953) disputes the relationship.

Biting almost always takes place in the open, although *Chrysops* sp. will bite inside houses ; a number of species will enter houses and native huts, sometimes at night attracted by light, but they do not appear to be seeking a blood meal. In Northern Nigeria we have noticed that the common species *Haematopota pertinens* is more prevalent on dull, overcast, days than on days when the sun shines unobscured. This was noticed also by Sanderson (1911) for this species in Nyasaland.

The males of Tabanids are presumed to feed on vegetation, and in the case of *Haematopota* in Northern Nigeria may often be taken by sweeping grasses in the wet-season from June to September.

Attraction to Light.

In Nigeria a few species of Tabanids are attracted to lights in houses at night. This is particularly true of *Tabanus subangustus*, which in Northern Nigeria on certain evenings between June and September will come to a light in very large numbers, particularly the females. At Katabu, near Kaduna, Vanderplank collected no fewer than 350 females of this species in one evening (Lewis, 1953, quoting Oldroyd). The attraction of *T. subangustus* to light was noticed by Simpson (1912) and by Mayer (1911), the latter author also recording that this species was attracted to white clothing. In our experience the species never bites after coming to a light, and one wonders why this species should be so active after nightfall. We have taken a female of *Haematopota pertinens*

at a light at 8 p.m., and a male of *Tabanus nyasae* at 9 p.m. *Tabanus secedens* has also been recorded as attracted by lights.

Attraction to Transport.

Tabanidae are attracted to trains on the Nigerian railways; as long ago as 1912 Simpson recorded that *Hippocentrum versicolor*, *Haematopota pallidipennis*, *Tabanus biguttatus* and *T. taeniola* could quite commonly be captured in passenger compartments of moving trains, although the flies were never found to attack passengers.

During the rains on almost any road journey in Northern Nigeria, Tabanids will be found entering the vehicle, settling on shaded parts or buzzing about in the cab when a halt is made. We have caught the following species either in or on road vehicles: *Haematopota pertinens*, *H. lacessens*, *H. pallidipennis*, *Ancala latipes*, *A. fasciata*, *Tabanus nyasae*, *T. taeniola*, *T. gratus*, *T. leucostomus*, *T. thoracinus* and *T. par*.

Tabanids are also attracted to canoes, barges, and the steamers of Nigeria's waterways, particularly in the coastal creeks and on the Niger and Benue Rivers; the flies will attack passengers on these craft when plying over half a mile from the banks. On the Niger in Northern Nigeria, between Yelwa and Pategi, we have obtained *Ancala fasciata*, *Tabanus taeniola*, *T. gratus* and *T. biguttatus* from trading canoes.

Lewis (1953) has recorded that Tabanidae are similarly attracted to road and rail transport in the Sudan; there is little doubt that trains and motor vehicles are an important agency in the dispersal of horse-flies in Nigeria.

(c) Seasonal Prevalence.

Crewe and O'Rourke (1951) and Davey and O'Rourke (1951*a*, *b*) have given some account of the seasonal prevalence of *Chrysops silacea* and *C. dimidiata* in the Cameroons and at Benin, southern Nigeria; their fluctuations in seasonal prevalence are based on biting activity, i.e. on the numbers of flies biting per boy-hour, an index commonly employed to show population fluctuations among blood-sucking Diptera. The F.B.H. method possibly gives a fairly accurate picture of changes in fly population but it can give no idea of actual fly density, as it leaves unknown the resting proportion of the female population and the population of males. It is, however, a presumption of the F.B.H. method that the ratio of flies biting to that of the non-biting population is constant throughout the year and, therefore, that valid comparisons of the F.B.H. results may be made from month to month or week to week.

Chrysops silacea and *C. dimidiata* are abundant at Benin from late May until early November, i.e. during the wet-season. After November density is low until April or May. It appears that when the population of *C. silacea* is high that of *C. dimidiata* is low and vice versa (Davey and O'Rourke, 1951*a*).

In southern Nigeria and the Cameroons, where conditions of temperature and humidity are more equable throughout the year, where there is no very long and desiccating dry-season, adult Tabanidae may be found in almost any month of the year. In the Northern Region, however, where conditions are far more severe, Tabanid activity is largely confined to the wet-season. As one goes further north in the country, towards the thorn-bush of the Sudan and Sahel Savannahs, the wet-season becomes shorter and the period of Tabanid activity

TABLE II.—*Seasonal prevalence of the Nigerian Tabanidae.*

Species.	Months. Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Dasycompsa cincta	no record											
Pangonia rüppellii	.	.	.	.	.	.	.	.	.	×	.	.
Nuceria semilivida	no record											
Subpangonia gravoti	.	.	.	.	.	×	.	.	.	.	.	.
S. grahami	.	.	.	.	.	×	.	.	.	.	.	.
Thriambeutes singularis	.	.	.	.	.	.	.	.	.	×	.	.
T. nigripennis	no record											
Thaumastocera akwa	×	.	.	×	.	.	.	.	.	×	.	×
Tabanocella stimulans	.	.	.	.	.	.	×	.	.	.	.	.
T. schoutedeni	no record											
T. praestabilis	no record											
Chrysops silacea	×	×	×	×	×	×	×	×	×	×	×	×
C. dimidiata	×	×	×	×	×	×	×	×	×	×	×	×
C. longicornis	.	.	×	.	×	.	.	.	.	×	.	×
C. distinctipennis	.	.	.	.	.	.	.	.	×	×	.	×
C. langi	.	.	.	.	.	.	.	×	×	×	×	.
C. centurionis	no record											
C. maximus	bred from larvae.											
C. griseicollis	.	.	.	.	.	.	.	.	.	.	×	.
C. zahrai	×	×	×	×	×	.	.	.	.	.	×	×
Ancala fasciata	×	×	×	×	×	×	.	×	.	×	×	.
A. africana	.	.	.	.	×	.	.	.	.	.	.	.
A. latipes	×	×	×	×	×	×	×	×	.	.	×	×
A. necopina	×	.	.	×	.	×	×	×	×	×	×	×
Atylotus agrestis	.	.	.	.	.	.	.	×	×	×	.	.
A. fuscipes	×	×	×	×	×	×	.	.	.	.	×	×
A. albipalpus	.	.	.	.	.	.	×	×	×	.	×	.
Tabanus billingtoni	.	.	.	.	×	.	×	.	×	.	.	.
T. marmorosus	.	.	.	.	×	.	.	×	.	.	.	.
T. obscurefumatus	.	×	×	×	×	.	×	×	×	.	×	.
T. sufis	.	.	.	.	×	×	×	×	×	×	×	×
T. pertinens	×	.	.	.	.	.	.	.	.	.	×	×
T. leucostomus	×	.	.	.	.	.	.	.	.	×	.	.
T. gratus	×	.	.	.	.	×	.	.	.	×	×	×
T. triquetrornatus	×	×	×	×	×	×	×	×	×	×	×	×
T. argenteus	.	.	.	.	×	.	.	.	.	.	.	.
T. niveinotatus	.	.	.	.	.	.	.	.	.	.	.	×
T. pluto	.	.	.	.	×	.	.	.	.	.	.	.
T. biguttatus	.	.	×	.	×	.	.	×	.	×	×	×
T. aeneus	.	.	.	.	.	.	.	.	.	×	×	×
T. ruficrus	.	.	.	.	.	.	.	.	.	×	.	.
T. brumpti	.	.	.	.	.	.	×	×	×	×	.	.
T. donaldsoni	.	.	.	×	×	.	.	.	.	.	.	.
T. scholae	.	.	.	.	.	.	.	.	.	.	×	.
T. par	.	×	.	.	×	×	×	×	×	×	×	×
T. thoracinus	.	.	.	×	×	×	×	.	.	.	.	.
T. besti	.	.	.	×	×	.	.	.	.	.	.	×
T. lubutuensis	×	×	×	×	×	.	.	.	.	.	×	.
T. obscurehirtus	.	.	.	.	×	.	.	.	.	.	.	.
T. combustus	.	.	.	×	.	.	.	.	.	.	.	.
T. secedens	.	×	×	×	×	×	×	×	.	×	×	.
T. quadrisignatus	×	×	×	×	.	.	×	×	×	×	×	×
T. simpsoni	.	.	.	.	.	×	.	.	.	×	.	.

TABLE II (*continued*).

Species.	Months.											
	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
T. conformis	×	×	.	×	×	×	×	×	×	×	×	×
T. longinquus	×	×	×	.	.	.	.	.	.	×	×	×
T. flavicoxa	×	×	×	.	.	.	.	.	.	.	.	.
T. fuscipleuris	×	.	.	.	.	.	.	.	.	.	.	×
T. taeniola	×	.	×	.	.	×	×	×	×	×	×	×
T. sugens	.	.	.	.	.	.	×	.	.	.	.	.
T. laverani	.	.	.	.	×	×	.	.	.	.	.	×
T. subangustus	.	.	.	×	×	×	×	×	×	×	.	.
T. nyasae	.	.	×	.	.	.	.	.	×	×	×	.
T. severini	×	.	.	.	.	.	.	.	.	.	.	.
T. chevalieri	.	.	.	.	.	.	.	.	.	.	×	×
Haematopota beringeri	.	.	.	.	.	.	×	.	.	.	.	.
H. pertinens	×	×	×	×	×	×	×	×	×	×	×	×
H. bullatifrons	.	.	.	.	×	×	×	×	×	.	.	.
H. griseicoxa	.	.	.	.	.	.	.	.	.	×	.	.
H. horrida	no record.											
H. crewei	×	×	×	.	.	.	.	.	.	.	×	.
H. barombi	.	.	×	.	.	.	.	.	.	×	×	×
H. guineensis	×	.	×	.	.	×	×	.	.	×	.	×
H. angustifrons	×	.	.	.	.	.	.	.	.	.	.	×
H. bantuana	.	.	.	.	.	.	.	×	.	.	.	.
H. hastata	.	.	.	.	.	×	×	×	×	.	.	.
H. abyssinica	.	.	.	.	.	×	×	×	×	×	×	×
H. gracilis	.	.	.	.	.	×	×	×	×	×	.	.
H. tenuis	.	.	.	.	.	×	×	×	×	.	.	.
H. decora	×	×	×	×	×	×	×	×	×	×	×	×
H. patellicorne	.	.	.	×	.	.	×	×	.	.	.	.
H. albihirta	.	.	.	.	.	×	.	.	.	.	.	.
H. pinguicornis	.	.	.	.	.	.	×	×	×	.	.	.
H. exiguicornuta	.	.	.	.	.	.	×	×	.	.	.	.
H. corsoni	.	.	.	.	.	.	.	.	×	.	.	.
H. tenuicrus	.	.	.	.	.	×	×	×	×	×	.	.
H. heptagramma	.	×	.	.	.	.	.	.	.	.	.	×
H. pallidipennis	.	.	.	.	.	.	.	×	×	×	×	×
H. lacessens	.	.	.	.	.	×	×	×	×	×	.	.
Hippocentrum versicolor	.	.	.	.	.	×	×	×	×	.	.	.
H. strigipenne	×	.	.	×	×	×	×	.	.	.	.	.
H. concisum	.	.	.	.	.	.	.	.	.	.	.	×

correspondingly reduced. During the short wet-season of the far north, however, flies may be extremely abundant and cause considerable discomfort, as in the region of Lake Chad. It is by no means certain that adults entirely disappear in the long dry-season of these parts, as *Tabanus taeniola* has been taken at Jega, Sokoto Province (12° 18′ N.) in late January, i.e. about the middle of the dry-season.

In Northern Nigeria different species appear to reach their peak numbers in different months of the wet-season ; thus *Tabanus subangustus* is commonest in June and July, *T. nyasae* in September and October, *Haematopota pertinens* in July and August and *H. pallidipennis* in October. At Kudaru, in Zaria

Province, *H. pertinens* has been caught at a density of 108 F.B.H. in July. *Tabanus taeniola* is most abundant at the end of the rains and in the early dry-season, i.e. October and November. Mayer (1911) stated that the peak of *Haematopota decora* fell in November, although flies were present every month of the year, and the peak of *Hippocentrum versicolor* in June–August, at Oshogbo, Southern Nigeria.

The flight-seasons of Ethiopian Tabanidae have been studied elsewhere by Vanderplank (1944) and Glasgow (1946). Vanderplank, working at Shinyanga, Tanganyika Territory, obtained *Tabanus taeniola* between November and June, *T. par* from December to February and *Atylotus agrestis* from December to March; the peak of *T. taeniola* fell in December. In Tanganyika, however, the wet-season is the reverse of that in Nigeria, lasting from November to May.

The known months of adult activity of the Nigerian and Cameroonian Tabanidae are shown by Table II, pp. 368–369.

6. Economic and Medical Importance.

The Nigerian Tabanidae have considerable economic and medical importance, by virtue both of the intense annoyance of their bites and of their capacity to transmit at least one major disease.

In some parts of Nigeria, Tabanidae occur in immense numbers during the wet-season and aggravate man and animals by the intensity and persistence of their attacks. In some parts animals are driven almost to a frenzy by the bites of these insects, particularly in Adamawa, where horses are very badly attacked, and in the Lake Chad area, where the flies direct their attentions to camels. In Northern Bornu the Kanuri tribesmen are in the habit of moving their cattle and watering them by night, largely to avoid Tabanid attacks as well as the heat of the day.

(a) Relation to Trypanosomiasis.

It has never been established in Nigeria that Tabanidae are capable of transmitting trypanosomiasis, but it seems probable that they are in some circumstances able to transmit mechanically certain trypanosomes pathogenic to livestock. It is not nowadays thought that there is any relation between Tabanidae and human sleeping sickness, but occasionally outbreaks of cattle trypanosomiasis occur in some of the stock-farms of Northern Nigeria and it is thought that Tabanids may be responsible; these stock-farms are situated in areas known to be tsetse-free for many miles, yet cows born and reared on the farms, which have never ventured outside the farm limits, have sometimes been found positive for trypanosomiasis. At one farm where a small outbreak occurred we found *Tabanus taeniola* and *T. par* to be abundant, and swarming round the cows in the stables; *Stomoxys* sp. were present also, and it seems likely that either this or the Tabanids were responsible for the cases of trypanosomiasis discovered.

In the far north of Nigeria camels are known to suffer from trypanosomiasis; camels occur in the northern parts of Sokoto, Katsina, Kano and Bornu Provinces, i.e. almost entirely outside the northern limit of tsetse-fly. In Map 1, the limit of tsetse is marked in relation to the area where camel trypanosomiasis has been found. It is clear that camel trypanosomiasis is not tsetse-borne and,

considering the great prevalence of Tabanidae in the wet-season of the far north, it seems very likely that these horse-flies are incriminated. In the Sudan both Knowles (1927) and Bennett (1929) suspected Tabanidae of the transmission of camel trypanosomiasis. Both authors considered *Tabanus taeniola* to be the most probable vector, Knowles suggesting also *T. sufis*. In Nigeria, *T. taeniola*, *T. par* and *Atylotus agrestis* are the species occurring most commonly in the areas in which camels are found, and, if Tabanids are in fact responsible for trypanosome transmission, these are the most probable carriers.

Many authors have thought that Tabanidae are suspect in the transmission of bovine and equine trypanosomiasis in other parts of Africa, and most of the species suspected by these authors occur in Nigeria. Vanderyst (1928) and Bouvier (1934) suspected that *Chrysops distinctipennis* was involved in the Congo ; Schwetz (1927) considered that *Tabanus biguttatus* probably spread *Trypanosoma congolense* among cattle in the Haut-Katanga district of the Congo ; but, on the other hand, Bedford (1926) wrote off the possibility of *T. biguttatus* mechanically transmitting nagana in Zululand as it is a species of fly not easily dislodged, and, therefore, one not inclined to make interrupted feeds. Poulton (1934) established in Uganda that Tabanidae could mechanically transmit trypanosomes through interrupted feeds ; he found that *T. congolense* could survive on *Tabanus thoracinus* if not more than fifteen seconds elapsed between feeding on one beast and feeding on the next. He also found viable trypanosomes in the stomach of *T. thoracinus* up to six hours after feeding, but was unable to say whether cyclical transmission was possible.

There is great need of investigation into the whole vexed question of mechanical transmission of trypanosomes ; so far as Nigeria is concerned it is virtually certain that the phenomenon occurs, but to what extent is unknown and the whole subject is still in the realms of conjecture.

(b) Loiasis.

Before the turn of the present century it was known that residents in Southern Nigeria were liable to a filarial infection of the eyes, and to enlargement of the wrists and other parts of the body, known as " Calabar swelling ". Europeans living in Eastern Nigeria and the Cameroons still commonly contract loiasis, which often causes them considerable discomfort.

It was suspected as early as 1895 that the causal organism of the disease, *Loa loa* (Guyot), might be transmitted by *Chrysops dimidiata*, but it was not until some eighteen years later that this was established when Leiper (1913), working in Nigeria, proved that both *Chrysops silacea* and *C. dimidiata* were capable of acting as vectors in nature. This discovery was followed up in Nigeria by Dr. and Mrs. A. Connal. Connal (1921) gave a brief preliminary note of his observations on filaria in *Chrysops*, followed (Connal, A. and Connal, S.L.M., 1921, *Trans. R. Soc. trop. Med. Hyg.* **15** : 131–134) by a more detailed account of infection rate results obtained from the dissection of 2,283 *Chrysops* caught at Sapele, Warri Province, Southern Nigeria. Of 2031 *C. silacea*, 16 (0·8 per cent) were infected, and of 252 *C. dimidiata*, 6 (2·4 per cent) were positive. Connal and Connal (1922) in the following year gave a detailed account of the development of *Loa loa* in both these species of *Chrysops*, and mapped the distribution of the known species of the genus from Nigeria (at that time only *C. silacea*, *C. dimidiata*, *C. distinctipennis* and *C. longicornis*). They established

that the metamorphosis of *Loa loa* occupied some 10–12 days in the fly, the larvae increasing tenfold in length during that time, and that development took place principally in the tissues of the abdomen.

There was from this time a definite lull in work on loiasis so far as Nigeria was concerned until recently, when a Loiasis Research Scheme was commenced in the British Cameroons, with its headquarters at Kumba. Loiasis is now receiving considerable attention as a major filarial disease of Nigeria and the Cameroons, and since 1948 a number of valuable papers have been published both on the disease and on the behaviour of its vectors.

In 1948 the breeding-places of the vector *Chrysops silacea* were found for the first time and described by Chwatt and others (1948), and Gordon and others (1948). Later Gordon and others (1950) discussed the whole problem of loiasis in West Africa, and provided a comprehensive bibliography of the subject. They mapped the distribution of loiasis together with the distribution of *Chrysops* subgenus *Kleineana* (that subgenus in which the known vectors of loiasis occur). In the present paper we map the distribution of the vectors (Map 8, *C. silacea*, and Map 9, *C. dimidiata*). Loiasis is not known to exist outside the range of these two flies, which suggests that the future discovery of other vectors is unlikely. Woodman (1949) in the Sudan found *C. distinctipennis* naturally infected with *Loa loa ;* this species occurs widely over the savannah regions of Northern Nigeria, and it is possible that it will ultimately be incriminated as a minor vector there. Gordon and others (1950) described in particular the *Chrysops* fauna of Kumba and Sapele, redescribing the sites in which the pre-imaginal stages are found ; they also provided some preliminary observations on the biting habits of the vectors of loiasis. They further gave a detailed account of the worm *Loa loa* and its ingestion by *Chrysops*. Since their work research has continued at Kumba and in other parts, notably Sapele and near Bamenda, and further information on adult behaviour of *C. silacea* and *C. dimidiata* has been given by Crewe and O'Rourke (1951), Davey and O'Rourke (1951*a*, *b*), Crewe (1953) and Kettle (1953).

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